



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| | | |
|---|----|---|
| (51) International Patent Classification: F16B 37/06, C23C 22/48 | A1 | (11) International Publication Number: WO 00/34672 (43) International Publication Date: 15 June 2000 (15.06.2000) |
| (21) International Application Number: PCT/US99/28950 | | Published |
| (22) International Filing Date: 07 December 1999 (07.12.1999) | | |
| (30) Priority Data: 198 56 613.1 08 December 1998 (08.12.1998) DE | | |
| (60) Parent Application or Grant EMHART, INC. [/]; O. SCHMITT, Klaus, G. [/]; O. KRENGEL, Michael [/]; O. SCHMITT, Klaus, G. [/]; O. KRENGEL, Michael [/]; O. MURPHY, Edward, D. ; O. | | |
| (54) Title: IMPROVED WELDABLE ALUMINUM STUD (54) Titre: GOUJON EN ALUMINIUM AMELIORE POUVANT ETRE SOUDE | | |
| (57) Abstract <p>A weld-on part made of aluminum or an aluminum alloy, such as but not limited to a stud (1), which has a surface which is at least partially provided with a layer (5) which contains a titanium containing material. The stud (1) is treated with a chrome-free passivating solution which imparts corrosion resistance while simultaneously causing a layer (5) of titanium containing material to be formed on at least a portion of the surface of the stud (1). The layer (5) of titanium containing material permits the stud (1) to be satisfactorily welded to a surface, without the occurrence of arc jumping or blowing, in part, by lowering contact resistance during the welding process.</p> | | |
| (57) Abrégé <p>Cette invention a trait à une pièce à rapporter par soudure en aluminium ou en alliage d'aluminium, à un goujon (1) notamment, sans toutefois se limiter à cette seule pièce. Cette pièce est revêtue, au moins en partie, d'une couche (5) renfermant un matériau contenant du titane. On traite ce goujon (1) à l'aide d'une solution de passivation dépourvue de chrome conférant une résistance à la corrosion tout en provoquant la formation d'un revêtement (5) fait d'un matériau contenant du titane sur une partie au moins de la surface du goujon (1). Ce revêtement (5) fait d'un matériau contenant du titane permet de souder convenablement le goujon (1) sur une surface sans survenue de saut d'arc ni de gonflement et ce, en partie, par réduction de la résistance de contact durant le soudage.</p> | | |

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | | | |
|----|--------------------------|----|--|----|--|----|--------------------------|
| AL | Albania | ES | Spain | LS | Lesotho | SI | Slovenia |
| AM | Armenia | FI | Finland | LT | Lithuania | SK | Slovakia |
| AT | Austria | FR | France | LU | Luxembourg | SN | Senegal |
| AU | Australia | GA | Gabon | LV | Latvia | SZ | Swaziland |
| AZ | Azerbaijan | GB | United Kingdom | MC | Monaco | TD | Chad |
| BA | Bosnia and Herzegovina | GE | Georgia | MD | Republic of Moldova | TG | Togo |
| BB | Barbados | GH | Ghana | MG | Madagascar | TJ | Tajikistan |
| BE | Belgium | GN | Guinea | MK | The former Yugoslav Republic of Macedonia | TM | Turkmenistan |
| BF | Burkina Faso | GR | Greece | ML | Mali | TR | Turkey |
| BG | Bulgaria | HU | Hungary | MN | Mongolia | TT | Trinidad and Tobago |
| BJ | Benin | IE | Ireland | MR | Mauritania | UA | Ukraine |
| BR | Brazil | IL | Israel | MW | Malawi | UG | Uganda |
| BY | Belarus | IS | Iceland | MX | Mexico | US | United States of America |
| CA | Canada | IT | Italy | NE | Niger | UZ | Uzbekistan |
| CF | Central African Republic | JP | Japan | NL | Netherlands | VN | Viet Nam |
| CG | Congo | KR | Kenya | NO | Norway | YU | Yugoslavia |
| CH | Switzerland | KG | Kyrgyzstan | NZ | New Zealand | ZW | Zimbabwe |
| CI | Côte d'Ivoire | KP | Democratic People's Republic of Korea | PL | Poland | | |
| CM | Cameroon | KR | Republic of Korea | PT | Portugal | | |
| CN | China | KZ | Kazakhstan | RO | Romania | | |
| CU | Cuba | LC | Saint Lucia | RU | Russian Federation | | |
| CZ | Czech Republic | L1 | Liechtenstein | SD | Sudan | | |
| DE | Germany | LK | Sri Lanka | SE | Sweden | | |
| DK | Denmark | LR | Liberia | SG | Singapore | | |

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

REC'D 12 DEC 2000

WIPO

PCT

(PCT Article 36 and Rule 70)

| | | |
|--|--|--|
| Applicant's or agent's file reference 0275M0305PCT | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) | |
| International application No. PCT/US99/28950 | International filing date (day/month/year) 07 DECEMBER 1999 | Priority date (day/month/year) 08 DECEMBER 1998 |
| International Patent Classification (IPC) or national classification and IPC IPC(7): F16B 37/06; C23C 22/48 and US Cl.: 411/171, 914; 148/247 | | |
| Applicant EMHART, INC. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

| | |
|--|--|
| Date of submission of the demand 31 MAY 2000 | Date of completion of this report 21 NOVEMBER 2000 |
| Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 | Authorized officer  FLEMMING SAETHER |
| Facsimile No. (703) 305-3230 | Telephone No. (703) 308-2168 |

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/28950

I. Basis of the report

1. With regard to the elements of the international application:*

 the international application as originally filed the description:pages _____ (See Attached) , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____ the claims:pages _____ (See Attached) , as originally filed
pages _____ , as amended (together with any statement) under Article 19
pages _____ , filed with the demand
pages _____ , filed with the letter of _____ the drawings:pages _____ (See Attached) , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____ the sequence listing part of the description:pages _____ (See Attached) , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is: the language of a translation furnished for the purposes of international search (under Rule 23.1(b)). the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

 contained in the international application in printed form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form. The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. The amendments have resulted in the cancellation of: the description, pages _____ NONE the claims, Nos. _____ NONE the drawings, sheets/fig. _____ NONE5. This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

**Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/28950

V. Reasons statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. statement**

| | | |
|-------------------------------|-----------------------------|-----|
| Novelty (N) | Claims <u>1-5 and 9-12</u> | YES |
| | Claims <u>6-8 and 13-15</u> | NO |
| Inventive Step (IS) | Claims <u>NONE</u> | YES |
| | Claims <u>1-15</u> | NO |
| Industrial Applicability (IA) | Claims <u>1-15</u> | YES |
| | Claims <u>NONE</u> | NO |

2. citations and explanations (Rule 70.7)

Claims 1-5 and 9-12 lack novelty under PCT Article 33(2) as being anticipated by Karmaschek. Karmaschek discloses an aluminum part with a titanium coating which may be welded to another member. The titanium is provided in a chromium free acidic solution and applied to the aluminum part by the aluminum contacting the solution for a sufficient amount of time. The lowering of a contact resistance would be inherent.

Claims 6-10 and 13-15 lack an inventive step under PCT Article 33(3) as being obvious over the prior art as applied in the immediately preceding paragraph and further in view of Dash. While Karmaschek does not disclose the part being a weld stud, Dash discloses the weld stud. At the time the invention was made, it would have been obvious for the skilled artisan to make the part of Karmaschek a weld stud because weld provide a recognized utility for weld parts as exemplified by Dash.

----- NEW CITATIONS -----

NONE

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/28950

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

I. BASIS OF REPORT:

This report has been drawn on the basis of the description,

page(s) 1-7, as originally filed.

page(s) NONE, filed with the demand.

and additional amendments:

NONE

This report has been drawn on the basis of the claims,

page(s) 8, as originally filed.

page(s) NONE, as amended under Article 19.

page(s) NONE, filed with the demand.

and additional amendments:

Claim page 9 and 10, filed with the letter of 01 November 2000.

This report has been drawn on the basis of the drawings,

page(s) 1, as originally filed.

page(s) NONE, filed with the demand.

and additional amendments:

NONE

This report has been drawn on the basis of the sequence listing part of the description:

page(s) NONE, as originally filed.

pages(s) NONE, filed with the demand.

and additional amendments:

NONE

REPLACED BY
ART 34 ASPECT

5

9

6. The part according to Claim 1, wherein the part is a weld stud having a welding face.

10

7. The part according to Claim 6, wherein at least a portion of the 5 welding face is provided with a titanium aluminum oxide layer.

15

8. The part according to Claim 7 wherein said part is applied to a 20 substrate having an average thickness of as little as 0.8 mm.

10 9. A method of producing a weldable aluminum part having titanium 25 dispersed along a surface thereof, said method comprising the steps of: providing an acidic solution containing titanium ions; and contacting the weldable aluminum part with the acidic solution for a sufficient 30 period of time to permit the application of titanium along a surface of the part.

15

35 10. The method according to Claim 9, wherein the acidic solution is a passivating solution.

40 11. The method according to Claim 9, wherein the acidic solution is 20 chromium-free.

45

50

55

5

10

12. The method according to Claim 9, wherein said acidic solution includes ALODINE 2040.

10

13. The method according to Claim 9, wherein the part is a weld stud having a welding face.

15

14. The method according to Claim 9, wherein at least a portion of the welding face is provided with a titanium aluminum oxide layer.

20

10 15. The method according to Claim 15 wherein said part is applied to a substrate having an average thickness of as little as 0.8 mm.

25

30

35

40

45

50

55



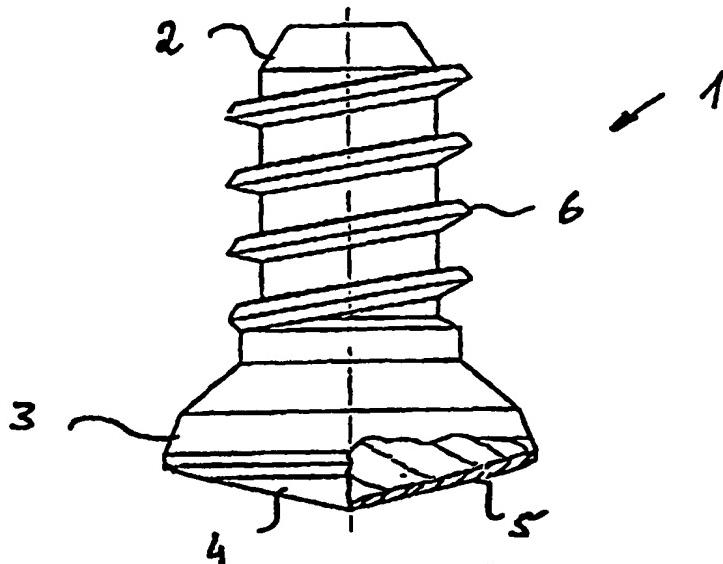
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| | | |
|---|--|--|
| (51) International Patent Classification ⁷ : | A1 | (11) International Publication Number: WO 00/34672 |
| F16B 37/06, C23C 22/48 | | (43) International Publication Date: 15 June 2000 (15.06.00) |
| (21) International Application Number: | PCT/US99/28950 | (81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). |
| (22) International Filing Date: | 7 December 1999 (07.12.99) | |
| (30) Priority Data: | | Published |
| 198 56 613.1 | 8 December 1998 (08.12.98) | With international search report. |
| (71) Applicant (for all designated States except US): | EMHART, INC. [US/US]; Drummond Plaza Office Park, 1423 Kirkwood Highway, Newark, DE 19711 (US). | |
| (72) Inventors; and | | |
| (75) Inventors/Applicants (for US only): | SCHMITT, Klaus, G. [DE/DE]; Alcenstrasse 22, D-35190 Giessen (DE). KRENGEL, Michael [DE/DE]; Giessenerstrasse 123, D-35396 Giessen (DE). | |
| (74) Agents: | MURPHY, Edward, D.; The Black & Decker Corporation, 701 E. Joppa Road, Towson, MD 21286 (US) et al. | |

(54) Title: IMPROVED WELDABLE ALUMINUM STUD

(57) Abstract

A weld-on part made of aluminum or an aluminum alloy, such as but not limited to a stud (1), which has a surface which is at least partially provided with a layer (5) which contains a titanium containing material. The stud (1) is treated with a chrome-free passivating solution which imparts corrosion resistance while simultaneously causing a layer (5) of titanium containing material to be formed on at least a portion of the surface of the stud (1). The layer (5) of titanium containing material permits the stud (1) to be satisfactorily welded to a surface, without the occurrence of arc jumping or blowing, in part, by lowering contact resistance during the welding process.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | | | |
|----|--------------------------|----|--|----|--|----|--------------------------|
| AL | Albania | ES | Spain | LS | Lesotho | SI | Slovenia |
| AM | Armenia | FI | Finland | LT | Lithuania | SK | Slovakia |
| AT | Austria | FR | France | LU | Luxembourg | SN | Senegal |
| AU | Australia | GA | Gabon | LV | Latvia | SZ | Swaziland |
| AZ | Azerbaijan | GB | United Kingdom | MC | Monaco | TD | Chad |
| BA | Bosnia and Herzegovina | GE | Georgia | MD | Republic of Moldova | TG | Togo |
| BB | Barbados | GH | Ghana | MG | Madagascar | TJ | Tajikistan |
| BE | Belgium | GN | Guinea | MK | The former Yugoslav Republic of Macedonia | TM | Turkmenistan |
| BF | Burkina Faso | GR | Greece | ML | Mali | TR | Turkey |
| BG | Bulgaria | HU | Hungary | MN | Mongolia | TT | Trinidad and Tobago |
| BJ | Benin | IE | Ireland | MR | Mauritania | UA | Ukraine |
| BR | Brazil | IL | Israel | MW | Malawi | UG | Uganda |
| BY | Belarus | IS | Iceland | MX | Mexico | US | United States of America |
| CA | Canada | IT | Italy | NE | Niger | UZ | Uzbekistan |
| CF | Central African Republic | JP | Japan | NL | Netherlands | VN | Viet Nam |
| CG | Congo | KE | Kenya | NO | Norway | YU | Yugoslavia |
| CH | Switzerland | KG | Kyrgyzstan | NZ | New Zealand | ZW | Zimbabwe |
| CI | Côte d'Ivoire | KP | Democratic People's Republic of Korea | PL | Poland | | |
| CM | Cameroon | KR | Republic of Korea | PT | Portugal | | |
| CN | China | KZ | Kazakhstan | RO | Romania | | |
| CU | Cuba | LC | Saint Lucia | RU | Russian Federation | | |
| CZ | Czech Republic | LI | Liechtenstein | SD | Sudan | | |
| DE | Germany | LK | Sri Lanka | SE | Sweden | | |
| DK | Denmark | LR | Liberia | SG | Singapore | | |
| EE | Estonia | | | | | | |

AMENDED CLAIMS

[received by the International Bureau on 22 May 2000 (22.05.00);
original claim 9 amended; remaining claims unchanged (1 page)]

6. The part according to Claim 1, wherein the part is a weld stud having a welding face.

7. The part according to Claim 6, wherein at least a portion of the welding
5 face is provided with a titanium aluminum oxide layer.

8. The part according to Claim 7 wherein said part is applied to a substrate having an average thickness of as little as 0.8 mm.

10 9. A method of producing a weldable aluminum part having titanium
dispersed along a surface thereof, said method comprising the steps of:

providing an acidic solution containing titanium ions; and contacting the weldable aluminum part with the acidic solution for a sufficient period of time to permit the application of titanium along a surface of the part; whereby the contact resistance of the part is lowered during a subsequent welding process.

10. The method according to Claim 9, wherein the acidic solution is a passivating solution.

11. The method according to Claim 9, wherein the acidic solution is chromium-free

IMPROVED WELDABLE ALUMINUM STUD

FIELD OF THE INVENTION

The invention relates generally to weldable materials and more particularly to weldable aluminum or aluminum alloy studs having a titanium containing material on at least a portion of a surface thereof, and methods of
5 making the same.

BACKGROUND OF THE INVENTION

Weld-on parts are used in many areas of industrial manufacture. They enable metal connections without making holes and form a link between a
10 basic structure and a component which is to be fastened. For example, a weld stud can serve to fasten pipe conduits, push buttons, plastic nuts or cable clips. Weld-on parts (e.g., studs) made of aluminum or aluminum alloys are known which can be welded to a basic part (e.g., a piece of sheet metal) which is also made of aluminum or aluminum alloys.

15 Under normal circumstances, freshly exposed aluminum in the presence of air immediately begins to oxidize. The oxide generally forms a layer over the entire surface and continues to grow thicker with the passage of time. The oxide layer is hard, adhesive, transparent, and up to several nanometers thick. In addition, in many circumstances, the thickness of the
20 oxide layer may vary from spot to spot. The oxide layer is largely insoluble in a pH range between 4.5 and 8.5. Thus, the oxide layer provides the part

with protection against corrosion. However, the oxide layer does, in some circumstances, adversely affect further processing steps to which the welded part may be subjected.

While this condition applies equally to sheet aluminum and to 5 aluminum studs, the process of manufacturing aluminum studs by cold working the metal makes the condition even worse because, after cold working, the surface may be comprised of areas of freshly exposed aluminum interspersed with different areas having varying oxide layer thicknesses. Thus, in the finished stud, the thickness of the oxide layer is random and 10 variable.

This condition causes problems during the welding of the studs to aluminum sheets because the energy required to release electrons from the oxide is lower than the energy to release electrons from bare aluminum. For example, in arc welding a stud, the arc may initiate at the center point of a 15 rounded weld head but, after some initial melting, the arc might jump or "blow" to an adjacent region, such as an area having a thick oxide layer. If this adjacent region is seriously off-center, the result may be an unsatisfactory weld.

Therefore, there exists a need for aluminum studs that have a relatively 20 consistent oxide layer which is capable of being satisfactorily welded to a surface, without the occurrence of arc jumping or blowing. There also exists a need for methods of producing such aluminum studs.

SUMMARY OF THE INVENTION

It accordingly is an object of the present invention to provide an aluminum stud that has improved weldability.

It is another object of the present invention to provide an aluminum
5 stud having a titanium containing material on at least a portion of a surface
thereof.

It is another object of the present invention to provide a method for
producing an aluminum stud that has improved weldability.

It is another object of the present invention to provide a method for
10 producing an aluminum stud having a titanium material on at least a portion
of a surface thereof.

In order to overcome the aforementioned disadvantages and achieve
many of the aforementioned objects, the present invention provides a
weldable part comprised of aluminum or an aluminum alloy, wherein the part
15 has a titanium containing material on at least a portion of a surface thereof,
wherein the layer of titanium containing material lowers contact resistance
during a welding procedure.

The present invention also provides a method of forming a titanium
containing material on at least a portion of at least one surface of a weldable
20 part of aluminum or an aluminum alloy. The method includes the steps of:
(1) providing a solution of titanium containing materials, and (2) contacting the
part with the solution for a sufficient period of time to permit the titanium

containing material to be applied to the part; wherein the layer of titanium containing material lowers contact resistance during a welding procedure.

A more complete appreciation of the present invention and its scope can be obtained from an understanding the accompanying drawings, which 5 are briefly summarized below, the followed detailed description of the invention, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partial cross-sectional view of a weld stud, in accordance 10 with one aspect of the present invention; and

Fig. 2 shows an elevational view of a weld stud having a threaded portion, in accordance with one aspect of the present invention.

The same reference numerals refer to the same parts throughout the various Figures.

15

DETAILED DESCRIPTION OF THE INVENTION

Initially, the weld-on part is pre-treated via known etching techniques to strip away aluminum oxides and thereby expose an aluminum or aluminum alloy surface. The titanium containing material is formed upon exposed 20 aluminum or aluminum alloy portion of the weld-on part by immersing the part in an acidic solution including a concentration of titanium ions and, preferably, a chromium free acidic solution containing titanium ions. By way of non-

limiting example, one suitable acidic solution believed to contain a sufficient quantity of titanium ions, initially or through sequential addition during the application step, is known as ALODINE 2040, which is commercially available from Henkel Surface Technologies (Madison Heights, Michigan). The acidic
5 solution utilized should provide a caustic passivation for the aluminum surface to be treated.

To prepare an ALODINE 2040 solution for use in accordance with the teachings of the present invention, 10-30 liters (preferably 15-20 liters) of the commercially available solution is mixed with a sufficient quantity of
10 demineralized water to form a 1000 liter bath. At the above described ratio, the resulting bath should have a pH value of 1.25.

As noted above, the weld-on part is preferably a weld stud such as that shown in Figs. 1 and 2, made of aluminum or an aluminum alloy. The weld stud 1 has a shank 2 and a head 3 extending along one end of the shank.
15 Preferably the head 3 has a conically tapered portion which forms a welding face 4.

To provide the weld-on part with a titanium containing material, the weld-on part is dipped or otherwise coated at a temperature of about 45°C in the acidic solution containing titanium ions. The treatment time, particularly
20 if the part is dipped, is generally between 30-90 seconds, wherein the solution should have a free acid count of between about 6.1 to 18.3. Thus, as should be understood by those skilled in the art, the acidic solution is controlled by

the determination of the free acid count as well as via a measure of the dissolved aluminum. For each 1.0 decrease in the free acid count, additional solution should be added to the bath.

Once at least the welding face of the weld stud is provided with the 5 titanium containing material, contact resistance between the weld-on part, a pin and the supporting structure or substrate is reduced. Providing the layer in the region of the welding face has a positive influence on the welding process. In particular, a qualitatively high grade welded connection is achieved, enabling the energy required to weld the pin to be reduced.

10 It is also preferred that the titanium containing material be of a sufficient thickness to prevent the formation of aluminum oxide on the weld-on part. As noted above, the thickness should be on the order of several nanometers.

Without being bound to a particular theory of the operation of the 15 present invention, it is believed that the ALODINE 2040 causes a relatively thin and uniform thickness layer of titanium aluminum oxide crystals to be formed on the surface of the weld-on part. Although the titanium aluminum oxide layer may grow with time, which is generally undesirable, the rate of growth is much lower than for non-passivated aluminum, and the thickness 20 of the titanium aluminum oxide layer remains relatively consistent.

The weld stud 1 is generally connected by means of arc welding to a structure or substrate (not shown) such as a sheet of a desired thickness.

For example, the weld studs may be adhered to sheets as thin as 0.8 mm on average. Preferably, the sheet will also be made of aluminum or an aluminum alloy. By way of non-limiting example, the sheet structure may be an autobody panel for a motor vehicle.

5 Referring to Fig. 2, there is shown a second embodiment of a weld stud 1 having a shank 2. However, in this embodiment, a Christmas-tree shaped thread 6 is formed on the shank 2. A welding head 3 is formed at a free end of the shank 2. The welding head 3 has a welding face 4, which comes into contact during arc welding with a substrate (not shown), such as
10 an aluminum or aluminum alloy piece of sheet metal. The welding face 4 is provided with a layer 5 of a titanium containing material.

The foregoing description is considered illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention
15 to the exact construction and process shown as described above. Accordingly, all suitable modifications and equivalents may be resorted to falling within the scope of the invention as defined by the claims which follow.

CLAIMS

What is claimed is:

1. A part attachable to a substrate via a welding process, comprised of aluminum or an aluminum alloy, wherein a surface of the part 5 to be welded to the substrate is provided with a titanium containing material capable of lowering the contact resistance between the part and the substrate during a welding process.

2. The part according to Claim 1, wherein the titanium containing 10 material is formed by contacting the part with an acidic solution containing titanium ions.

3. The part according to Claim 3, wherein the acidic solution is a passivating solution.

4. The part according to Claim 3, wherein the acidic solution is 15 chromium-free.

5. The part according to Claim 1, wherein said acidic solution 20 includes ALODINE 2040.

6. The part according to Claim 1, wherein the part is a weld stud having a welding face.

7. The part according to Claim 6, wherein at least a portion of the
5 welding face is provided with a titanium aluminum oxide layer.

8. The part according to Claim 7 wherein said part is applied to a substrate having an average thickness of as little as 0.8 mm.

10 9. A method of producing a weldable aluminum part having titanium dispersed along a surface thereof, said method comprising the steps of:
providing an acidic solution containing titanium ions; and
contacting the weldable aluminum part with the acidic solution for a sufficient period of time to permit the application of titanium along a surface of the part.

15

10. The method according to Claim 9, wherein the acidic solution is a passivating solution.

20 11. The method according to Claim 9, wherein the acidic solution is chromium-free.

10

12. The method according to Claim 9, wherein said acidic solution includes ALODINE 2040.

13. The method according to Claim 9, wherein the part is a weld
5 stud having a welding face.

14. The method according to Claim 9, wherein at least a portion of the welding face is provided with a titanium aluminum oxide layer.

10 15. The method according to Claim 15 wherein said part is applied to a substrate having an average thickness of as little as 0.8 mm.

1 / 1

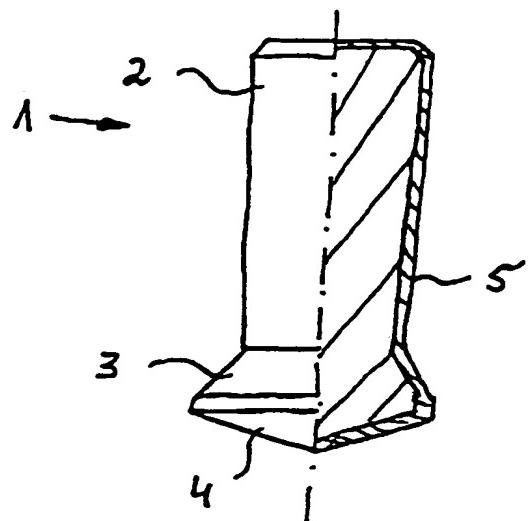


Fig. 1

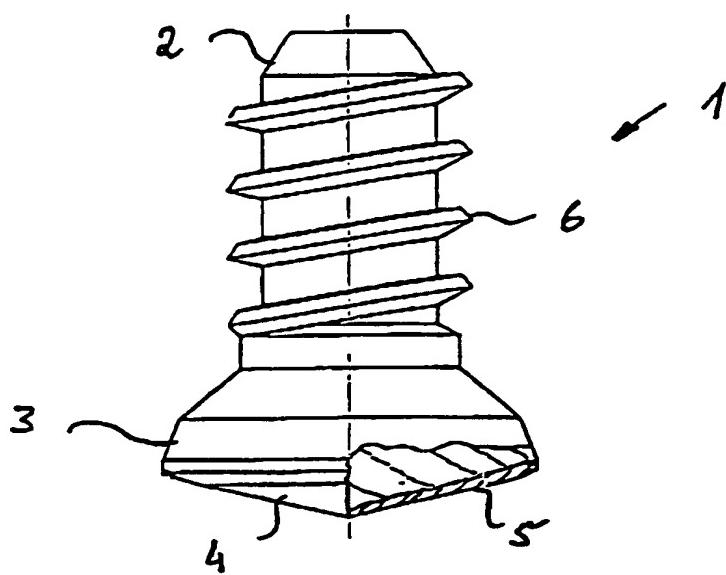


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/28950

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :F16B 37/06; C23C 22/48
US CL :411/171, 914; 148/247

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 411/171, 901, 914; 148/247; 219/99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| X ---- | US 5,584,946 A (KARMASCHEK et al.) 17 December 1996 (17-12-96), entire document. | 1-5,9-12 ----- |
| Y | | 6-8,13-15 |
| Y | US 2,858,414 A (DASH) 28 October 1958 (28-10-98), entire document. | 6-8,13-15 |

Further documents are listed in the continuation of Box C. See patent family annex.

| | | |
|---|-----|--|
| * Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| *A* document defining the general state of the art which is not considered to be of particular relevance | "X" | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| *E* earlier document published on or after the international filing date | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" | document member of the same patent family |
| *O* document referring to an oral disclosure, use, exhibition or other means | | |
| *P* document published prior to the international filing date but later than the priority date claimed | | |

Date of the actual completion of the international search

21 FEBRUARY 2000

Date of mailing of the international search report

21 MAR 2000

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer
Flemming Saether
FLEMMING SAETHER

Telephone No. (703) 308-2168

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/28950

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :F16B 37/06; C23C 22/48
US CL :411/171, 914; 148/247

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 411/171, 901, 914; 148/247; 219/99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| X ---- | US 5,584,946 A (KARMASCHEK et al.) 17 December 1996 (17-12-96), entire document. | 1-5,9-12 ----- |
| Y | | 6-8,13-15 |
| Y | US 2,858,414 A (DASH) 28 October 1958 (28-10-98), entire document. | 6-8,13-15 |

Further documents are listed in the continuation of Box C. See patent family annex.

| | | |
|---|-----|--|
| * Special categories of cited documents. | *T* | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| *A* document defining the general state of the art which is not considered to be of particular relevance | | |
| *B* earlier document published on or after the international filing date | *X* | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | *Y* | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| *O* document referring to an oral disclosure, use, exhibition or other means | *E* | document member of the same patent family |
| *P* document published prior to the international filing date but later than the priority date claimed | | |

| | |
|---|--|
| Date of the actual completion of the international search 21 FEBRUARY 2000 | Date of mailing of the international search report 21 MAR 2000 |
|---|--|

| | |
|---|--|
| Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230 | Authorized officer <i>John Flemming Saether</i> FLEMMING SAETHER Telephone No. (703) 308-2168 |
|---|--|

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT**NOTIFICATION OF ELECTION**
(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C.20231
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

| | |
|---|---|
| Date of mailing (day/month/year) 02 August 2000 (02.08.00) | To: Assistant Commissioner for Patents United States Patent and Trademark Office Box PCT Washington, D.C.20231 ETATS-UNIS D'AMERIQUE in its capacity as elected Office |
| International application No. PCT/US99/28950 | Applicant's or agent's file reference 0275M0305PCA |
| International filing date (day/month/year) 07 December 1999 (07.12.99) | Priority date (day/month/year) 08 December 1998 (08.12.98) |
| Applicant SCHMITT, Klaus, G. et al | |

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

31 May 2000 (31.05.00)

in a notice effecting later election filed with the International Bureau on:

2. The election was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

| | |
|---|---|
| The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35 | Authorized officer Olivia RANAIVOJAONA Telephone No.: (41-22) 338.83.38 |
|---|---|